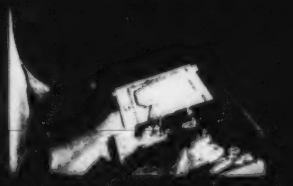
ANNUAL REPORT 1988

ALBERTA RESEARCH COUNCIL



Letter of Transmittal

Sessional Paper No. 124/89
1 Session, 22 Legislature

To The Honorable Les Young
Minister of Technology, Research & Telecommunications

In accordance with the requirements of the Alberta Research Council Act, I have the honor to present to you the Annual Report of the Alberta Research Council for the calendar year 1988.

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Respectfully submitted,

Fred Bradley

Fred D. Bradley, M.L.A.
Chairman of the Board
Alberta Research Council

February 1989

Corporate Profile

The Alberta Research Council is a crown corporation of the Province of Alberta, offering a diversified range of scientific, engineering and technological research and testing capabilities in:

Oil Sands and Hydrocarbon Recovery: Bitumen recovery processes by steam and/or additive injection in the Athabasca and Cold Lake oil sands; geological and hydrogeological investigations at Athabasca, Cold Lake and Peace River; numerical modelling; maintenance of an oil sands sample bank.

Coal and Hydrocarbon Processing: Coal utilization research including agglomeration, gasification, combustion, co-processing; hydrocarbon upgrading; coal geology; classification and evaluation of Alberta coals by pyrolysis and petrography.

Biotechnology: Microbiology; fermentation technology and pilot level scale up; plant cell culture.

Forestry: Forest products development and testing of panel products using Alberta forest resources; application of technologies such as Land Related Information Systems to the forestry sector.

Geological Survey: Geological studies and mapping; mathematical modelling of fluid flow in deep sedimentary basins.

Terrain Sciences: Management of soil and water resources; geographic information systems; land reclamation for use after surface mining.

Resource Technologies: Environmental sensing and modelling; civil engineering in transportation and rivers.

Advanced Technologies: Computer-based technologies including automation, expert systems and robotics for application and transfer to industry.

Materials and Testing: Research and development in advanced materials; testing laboratories for materials, gasoline and oil, and industrial chemicals testing and analysis.

Service to Industry: Providing short-term advisory and technical service to Alberta companies; administration of the National Research Council's Industrial Research Assistance Program (IRAP) for Alberta industry.

The Electronics Test Centre: Provides testing and evaluation services to electronic and telecommunications products manufacturers requiring product certification, and provides companies with engineering assistance in planning and developing new products.

The Alberta Research Council operates five specialized information centres in industrial information, electronics industry information, oil sands, geology and waste materials exchange.

The Alberta Research Council is a member of the Association of Provincial Research Organizations Inc. (APRO).

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Report from chairman of the board and president

In Alberta, we are fortunate to have a government which commits to the Alberta Research Council the highest level of funding of any provincial research organization. But Canada requires a greater commitment to research and development and vigorous steps are needed to stimulate science-based innovation and industry-driven R&D to improve our productivity. All segments of the research community – industry, government, universities and research institutes – recognize the need to work together. Networking is the Canadian answer to R&D effectiveness.

The Alberta Research Council has taken a leading role in forging these networks. Through new memoranda of understanding with the National Research Council, SED Systems Ltd., Saskatoon, the University of Calgary, and with the federal Ministry of State for Science and Technology, we have formal agreements to broaden the scope of each signatory's capabilities. Our first Memorandum, with the Saskatchewan Research Council, led to a stimulating two-day capabilities seminar in April, during which both organizations examined their collective resources and potential for joint projects which can support the private sector in our two provinces.

Our ties abroad are becoming more important as Alberta expands its interests in international commerce. For example, the Research Council and the American Plywood Association signed a cross certification agreement which will assist the forest products industry.

By promoting exchanges with foreign scientific institutes, the Alberta Research Council is acting as a gateway to Alberta industry seeking new markets. One of our biotechnologists has been invited to act as chairman of the Wuhan (China) International Cooperative Asssociation for Promotion of Biotechnology and, on behalf of the Alberta Research Council, has signed a letter of intent which is expected to lead to establishment of a biotechnology scale up and production centre in Wuhan. The Research Council would play a role, not only in helping the Wuhan biotechnology community, but in opening the door of opportunity for Alberta businesses interested in contracting services or materials.

Alberta Research Council oil sands scientists and geologists are working in Indonesia under contract to assist the Indonesian government in developing its asbuton deposits for use as road bed material. Our geologists have helped colleagues in Jordan and Guyana. Our Forest Products Laboratory has performed waveboard experiments using Alberta aspen and Australian pine for a client in Australia.

In late 1987, we selected ten new initiatives as potential projects to meet the challenges of the future. They range from additions to our infrastructure to participation in major Canadian technology endeavors, including opportunities in hydrogen and the application of biotechnology in space. Some of these initiatives are well under way. In the biotechnology pilot plant, we received the 15,000 litre fermentor and added two more 7,500 litre fermentors; a Construction

Fred D. Bradley, left, and Dr. C.W. Bowman

Technology Centre laboratory is being set up in cooperation with the Canadian Construction Research Board; our joint research venture program is being expanded, and a land-related information system program is very active.

A new department related to forestry and forest products research and development was created to provide that industry with improved access to the technology related to forest management and higher value forest products. We are in the preliminary stages of setting up a new materials and testing department with accommodation for new initiatives in advanced materials.

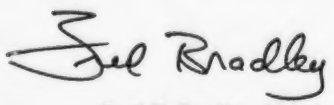
The Alberta Research Council's goal to be a pacesetter organization would not be possible without the dedication and commitment of our staff. Our world class reputation has been built by the men and women who work throughout the Research Council. To honor 20 staff members for their achievements, members of the Board joined senior management at an awards night dinner in March. (See page 32).

In our outreach to the community the Research Council held several events in 1988. At Clover Bar, the Oil Sands and Hydrocarbon Recovery Department marked 60 years of oil sands research by inviting energy representatives to an open house; in the fall, an open house for industry was held at our main laboratories and headquarters, Mill Woods; and two open houses for the public, one at our coal research facilities in Devon, and the other at Mill Woods, drew large, interested audiences. In addition, our Board of Directors met members of the business community in Calgary and Medicine Hat in conjunction with meetings in those communities.

To Clay Iverson, who retired from the Board this year, we express our appreciation for his wisdom and his contributions to the Research Council over the past three years.

We welcome to our Board four new members appointed in December for three-year terms: Dr. Robert B. Church, associate dean (research), Faculty of Medicine at the University of Calgary; Dr. Renee Elio, assistant professor, Department of Computing Science, University of Alberta; H. MacKenzie Millar, vice-president and secretary-treasurer, Millar Western Industries Ltd., and president of Millar Western Pulp Ltd.; and Dr. D. Robert Weir, general manager, Technology, Sherritt Gordon Limited.

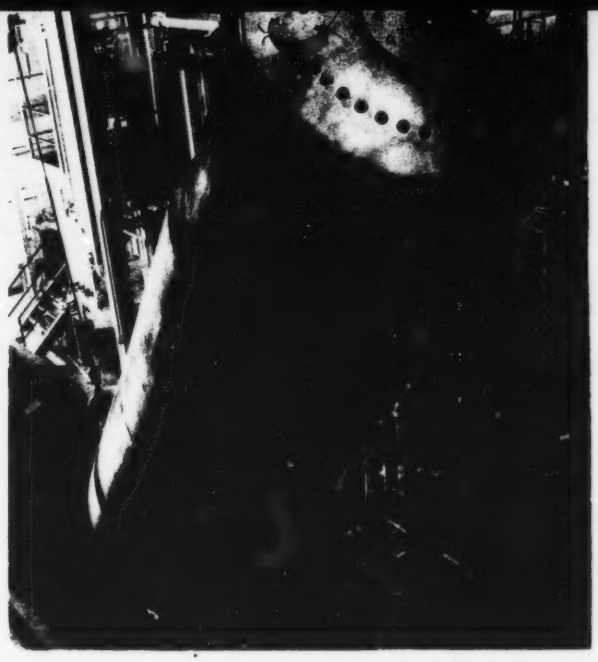
This year has been about change at the Alberta Research Council as the organization sets its goals for the 1990s. In addition to the endeavors briefly outlined here, all the departments and support staff have been making extraordinary efforts to meet client needs. On the following pages are summaries of the year's work, which reflect the diversity and scope of activity at the Alberta Research Council.



Fred D. Bradley, M.L.A.
Chairman of the Board

Clem W. Bowman
President

Highlights



Biotechnology pilot plant's new 15,000L fermentor being lowered into position last September.

Energy

Oil Sands and Hydrocarbon Recovery: Membership in Industry Access Program doubles in 1988, indicating the value of this cooperative effort. Funded jointly with the Alberta Oil Sands Technology and Research Authority (AOSTRA), the Access Program is designed to address field problems associated with in situ oil recovery from heavy oil and oil sands formations.

Coal and Hydrocarbon Processing: Work in pyritic sulfur removal from coal results in second major consortium project, funded by the U.S. Department of Energy. The consortium is headed by Southern Company Services, Inc. The Alberta Research Council will receive up to US$2.5 million for its contribution to the US$12 million project.

Biotechnology: Installation of new 15,000L fermentor and two 7,500L fermentors boosts fermentation capacity to more than 37,500L; Biosys, the first user, now market testing Biosafe - a biological pesticide developed for production at the Alberta Research Council.

Natural Resources

Geological Survey: Major field studies to explore for aggregate deposits undertaken by Mineral Resources Group. In Peace River area, aggregate needed for building infrastructure to support new pulp operation; in Wandering River district, for access road development to Fort McMurray.

Forestry: New department formed to expand scope of research and development in support of key Alberta resource industry. Cross certification agreement signed with the American Plywood Association will assist the forest products industry.

Terrain Sciences: Four-year study, sponsored by Suncor Inc. and the Alberta Research Council, to assess feasibility of high-lime sludge as a land spreading agent, completed. Results indicate sludge used as liming agent does not produce deleterious effects to soil or crops.

Resource Technologies: SWIFT, a Severe Weather Intelligent Forecast Terminal, delivered to the Atmospheric Environment Service. SWIFT is a software system which forecasts the location and intensity of severe summer storms, based on traditional observations and forecasts, modified and enhanced by rules which embody the knowledge of an expert forecaster.

Industrial Technologies

Advanced Technologies: Alberta Research Council named as a subcontractor in four proposals for applications of artificial intelligence approved under Canadian Space Program. Two contracts signed, dealing with a fault detection application, and crew training for the Mobile Service System of the Space Station.

Service to Industry: Network of technology field advisors expanded to include Red Deer. Alberta Research Council, National Research Council and Alberta construction industry jointly establish Alberta Construction Technology Centre to facilitate technology transfer to this industry.

Materials and Testing: New department formed to focus on advanced materials research. Industrial Services Laboratory accepted by the Canadian General Standards Board as testing facility for vapor barrier polyethylene sheet, insulation products and canola oil packaging.

Joint Research Venture Program: Eight projects completed and another 12 projects under way. Design and installation of automated work cell for Standen's Limited represents first use of a six-axis robot in the industrial workplace in Alberta. Benefits are reduction of risk to the human worker and improved productivity.

Electronics Test Centre: Projected revenues for 1988 totalling $600,000 indicate a 35 per cent increase over last year. Test Centre passes first audit conducted by the Department of National Defence (DND) and the Standards Council of Canada.

Energy

Oil Sands and Hydrocarbon Recovery

Research contracts and joint research projects with industry are an important component of the Oil Sands and Hydrocarbon Recovery Department's research effort in support of the vital petroleum industry in Alberta.

Research contracts with Esso Resources Canada Ltd., in support of the OSLO project, resulted in an increased understanding of factors affecting the separation and flotation process that will be considered in the design of the OSLO extraction plant. Work continues on applying these findings to pilot scale experiments that will further identify process improvements.

Contracts with BP Canada Inc. and Mobil Oil Canada Ltd. concentrated on the in situ recovery of oil from their respective field pilots in bitumen and heavy oil. Sampling and detailed analysis of samples from the reservoir and produced fluids resulted in a better understanding of the movement of oil under thermal stimulation and the mechanisms that play a part in the recovery process. This understanding will be used to improve oil recovery and reduce costs. Other contracts with Esso and Mobil concentrated on the study of reactions between the hot fluids and the rock matrix. New techniques developed to sample and measure the reactions taking place in the reservoir led to the ability to predict possible scaling problems. Ways to prevent such problems can now be addressed in each situation.

A joint research venture project with Western Geophysical Company of Canada has demonstrated the technical feasibility of using high resolution seismic mapping to track miscible enhanced oil recovery (EOR) flood bank movement in at least some Alberta light oil reservoirs. This will provide reservoir engineers with feedback on how their production strategies are working and allow modification to the process to improve the efficiency of enhanced oil recovery. The project is continuing with studies of the characteristics of reservoirs that qualify for this type of monitoring.

A project jointly funded by Syncrude Canada Ltd., CANMET and the Alberta Research Council was started in 1987 to study the fundamental properties of tailings sludge, produced by the hot water extraction process used by Syncrude and Suncor Inc. Scientists at each of the organizations are cooperating in seeking an effective and economical way to de-water the sludge material and return the clay and water safely to the environment.

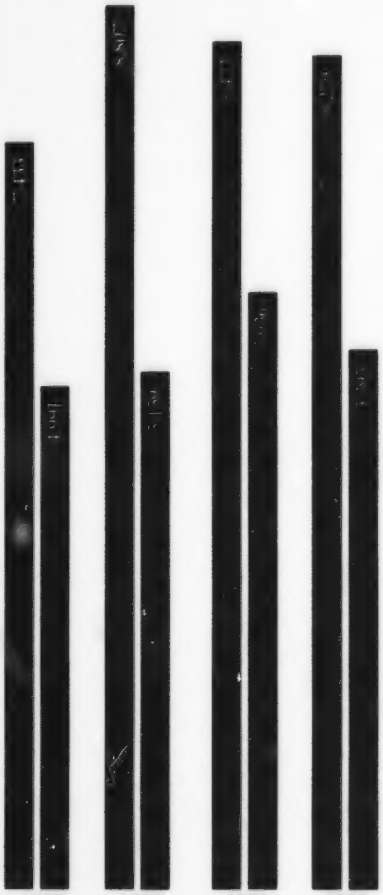
Contracts with a Norwegian company with production in the North Sea, and a consortium with production in China, employed the Alberta Research Council to study waxy crudes and problems associated with their production. These studies have resulted in the development of models to help describe waxy crudes and ways they can be handled during production and treatment.

Contract studies with a U.S. multinational oil company on rock-steam reactions showed that the elements of the produced fluids can be used to monitor the mixing of the injection and formation waters in their heavy oil field in California. New sampling techniques were developed for the collection of hot water and gas samples

Oil Sands and Hydrocarbon Recovery

■ Annual Expenditures
■ Contract Income

(Thousands of dollars)



at wellhead conditions. The composition of the produced fluids led to the development of mineral and gas geothermometers and a reactive carbonate index that helps describe the recovery process and aids in process modifications to improve oil recovery.

The large scale linear programming energy models, developed at the Alberta Research Council for the Canadian Energy Research Institute (CERI), were expanded to include electricity. These models are used to study the impact of different world energy price-supply-demand scenarios and help identify priority research areas.

The mainstay of the department's medium-to-long-term generic research program is the industry access Core Research Program, jointly funded by the Alberta Research Council and the Alberta Oil Sands Technology and Research Authority (AOSTRA). Industry membership doubled in 1988, indicating the value of this cooperative program, designed to address field problems and develop an understanding of fundamental mechanisms associated with the use of steam-based processes for in situ oil recovery from heavy oil and oil sands formations in Alberta.

Experiments in physical simulators at the Research Council, using small quantities of caustic and carbon dioxide in steam flood have resulted in a process that shows significantly improved bitumen recovery over that obtained through the use of steam only. The understanding of mechanisms affecting oil recovery during steam flooding was increased with the measurement of the extent of the influence of capillary pressure on the fluid dynamics of the steam front propogation. This was incorporated into numerical models, resulting in an excellent match with experimental results. A new high pressure visual cell was fabricated to study and measure ternary phase behavior of bitumen-gas mixtures in the presence of steam and water. It also gives a better understanding of the parameters affecting the mobilization and flow of bitumen during in situ recovery.

Scaling in the well bore or in the region near the well often causes serious problems of plugging and reduced or stopped production. New techniques were developed for monitoring scale deposition near the production well and these techniques are being applied to the study of reducing or eliminating scale formation.

The AOSTRA/Alberta Research Council Strategic Program, funded by AOSTRA, is a program of research to apply concepts, results and insights gained from the laboratory to individual field situations, and to investigate and evaluate specific problems in field operations. One of the major problems reducing production by in situ recovery of heavy oil is the presence of barren zones and/or underlying active water zones in the petroleum reservoirs. Efficient injection and delivery of diverting or blocking agents would assist in improving conformance control and increase recovery efficiency. Ultra microbacteria were used in simulator experiments to demonstrate that they could be injected to appropriate locations in the formations.

Other studies relating to problems of fingering, fluid segregation, water coning and lack of communication between wells resulted in a better understanding of the mechanisms of flow of steam and oil through the porous medium. Technology was developed to aid in tailoring steam-simulated recovery improvement processes related to the particular reservoir conditions encountered.

The highly viscous crude oils of Alberta create many well bore related problems. A pump and well bore physical simulater was installed in 1988 to apply to the study of fluid production rates, pump efficiencies, bottom hole conditions, and to test field-scale pumps. A full scale flow visualization system, together with a laser Doppler fluid velocity measurement system was also constructed to further the understanding of the interactions between flowing multicomponent fluids and pump design.

All oil sand extraction processes, whether in situ or surface mined, are governed to a large extent by the interactions among water, bitumen, clay and dissolved salts. To gain a better understanding of the behavior of clay-bitumen-sand suspensions, a newly acquired instrument was used to measure the electrokinetic potentials and stability of these dispersions. Measurements were made on water-in-oil emulsion systems that previously could not be studied because of their complex nature. The results from this work were correlated to the recovery of bitumen by froth flotation,

[redacted]

Dr. Jerzy Janiak studies mineral matter from coal/oil agglomerates.

breaking of emulsions, and to the study of oil-water-solid suspensions.

The Oil Sands Sample Bank, funded by AOSTRA, continued to provide samples from pilot and commercial operations in Alberta and Saskatchewan to industry and university researchers for their studies in process development and evaluation. Alberta Research Council staff contributed to the Alberta Committee on Oil Sands Analysis and were the major contributors to a manual on analytical methods for characterizing bitumen and heavy oils.

Coal and Hydrocarbon Processing

The Coal and Hydrocarbon Processing Department carries out research and development for industry in a number of areas including agglomeration, gasification, combustion and co-processing.

Laboratory and pilot scale work of the agglomeration group in recent years has resulted in development of three processes based on coal/oil agglomeration principles. Two main objectives were upgrading of low rank coals and utilization of wastes and by-products of the oil industry. Two years ago this work led to a $4.7 million agglomeration project between the Research Council and the Electric Power Research Institute, Palo Alto, California, which attracted participation from 18 private sector resource and utility companies and government agencies.

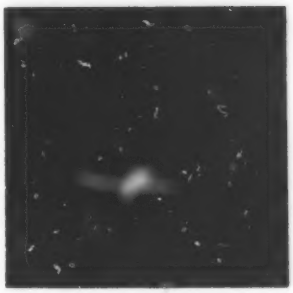
The group also developed an effective method for removal of pyritic sulfur from bituminous coals. The work in pyritic sulfur removal from coal by the Alberta Research Council has resulted in a second major consortium project, initiated this year, and funded by the U.S. Department of Energy under its clean coal program. The consortium is headed by Southern Company Services, Inc. and the Alberta Research Council will receive up to US$2.5 million for its contribution to the US$12 million project.

The Alberta Office of Coal Research and Technology (OCRT) works closely with the Alberta Research Council and funds projects in co-processing, coal derived liquids characterization, combustion and gasification.

An OCRT program in secondary upgrading of co-processing liquid products demonstrated that sufficient nitrogen and sulfur could be removed to meet refinery feedstock specifications. Feedstocks and products from three co-processing conditions were analysed with emphasis on asphaltene and resins fractions. Application of these techniques demonstrated the effects of different processing conditions on the detailed chemical makeup of the liquid products.

In parallel to this OCRT-funded work, the Alberta Research Council funded and carried out fundamental research on methods to characterize coal liquids. One such method is the application of a carbon isotope technique, using facilities and instrument expertise from the University of Alberta.

Other OCRT work was aimed at examination of physical changes of coal particles during combustion. Petrographic studies showed one low volatile bituminous coal was unique in that it formed a char with anisotropic coke structure. As well, experimental techniques were put in



place for determining devolatilization and char combustion characteristics of pulverized coal samples at temperatures up to 1500 C. Such data is required for numerical simulations to predict both flame properties and pollutant emissions. For the next level of work, a unit is being constructed for advanced studies of coal combustion reactions using optical pyrometry.

In OCRT gasification research, work proceeded on design, construction and testing of laboratory scale units for characterization of gasification properties of Alberta coal. With the technical and financial support of a joint industry/government gasification technical committee, several Alberta coals were sent for evaluation in gasifier technologies developed by Texaco Inc., Shell and British Gas. Using data from these evaluations, Research Council staff demonstrated that gasifier product gas compositions could be predicted for several commercial gasifiers using chemical equilibrium concepts. In conjunction with this work, Alberta Research Council staff are also major participants in a Canadian study to establish a gasification testing protocol and apply this protocol to a broad range of Canadian coals.

In other co-processing work, the Alberta Research Council is in the second year of a five-year contract agreement with Canadian Energy Developments Inc. (CED) to develop technology for the simultaneous upgrading of Alberta subbituminous coal and bitumen. Based on original work conducted by the Alberta Research Council, and results from the current contract, CED has developed a high conversion co-processing scheme to give high distillate yield from Vesta coal and Cold Lake bitumen. This scheme is currently tested in CED's 10 Kg/h process development unit located at the Research Council's Nisku High Pressure Facility.

The main research conducted in bitumen and heavy oil upgrading is carried out under a five-year hydrocarbon upgrading program, jointly funded by AOSTRA and the Alberta Research Council. In 1988, the research team made considerable progress in development of second generation bitumen upgrading processes. Activities in a high conversion processes project were focused on pilot plant tests of a novel bitumen upgrading process that uses homogeneous, liquid-phase catalysts to convert bitumen to high quality distillate. In parallel, the mechanisms of a coke formation project investigated the retrograde conversion of liquid hydrocarbons to solid coke under thermal process conditions. The success of this project will eventually lead to improvements in the prevention of coke formation in commercially operated reactors.

Finally, under the AOSTRA/Alberta Research Council joint program, research was undertaken to develop a "designer" catalyst for low severity, high activity hydrogenation of bitumen. This exploratory research focused on identifying critical properties of high performance catalysts for bitumen upgrading.

In a jointly funded bitumen upgrading project with Gulf Canada Resources Limited, the Alberta Research Council is conducting work to develop a donor solvent process. The process, which shows some advantages over competitive technologies, could play an important part in development of Alberta's resources. The criteria which determine the quality of donor solvent have been established and the behavior of various components of the residua during the process has been clarified. A small pilot plant unit for scale up of the process has been constructed, commissioned and is now operating.

The Alberta Research Council also funded exploratory work in reactor

Technologist Anna Truong with visitors to Coal Research Centre Devon open house. More than 4,000 people toured various Research Council laboratories in 1988.

dynamics. The efficiencies of processes for either the liquefaction of coal, upgrading of bitumens or resids, or co-processing of coal and bitumen, depends on the behavior of all phases within the reactor. Under the Canada/Japan Coal Liquefaction Cooperative Agreement a senior scientist from Japan is working with Alberta Research Council scientists to study the behavior of gas bubbles at high temperatures and pressures.

The Alberta Research Council began an initiative in the area of natural gas conversions to longer chain hydrocarbons and transportation fuels. One project is a jointly funded venture of the Alberta Research Council and CANMET. A series of potential catalysts based on new combinations of components is being evaluated for effectiveness in the conversion of methane to ethane and ethylene.

Geology

During 1988, the Alberta Geological Survey continued to provide information and expertise to support provincial government departments in the management of the province's earth resources, and assist industry in exploiting these resources.

To forge closer links with clients, a strategic planning and business development coordinator was appointed and a program of visits to industry was initiated. Part of this effort included hosting Research Forum '88 in Calgary, attended by more than 500 representatives from the geological community.

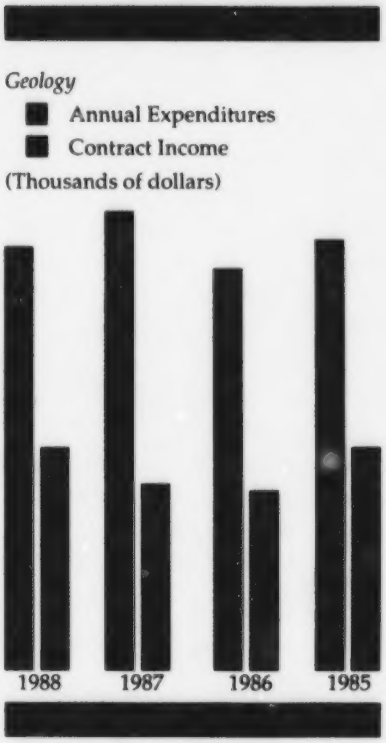
The Joint Oil Sands/Geology program, funded on an equal, tripartite basis by the Alberta Research Council, Alberta Energy, and AOSTRA covers two major technical projects: Resource Characterization and Reservoir Analysis.

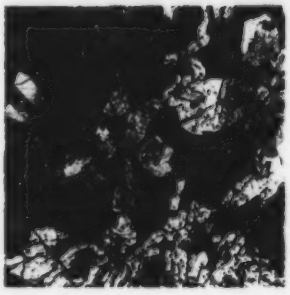
The Resource Characterization program completed its work on the central portion of the Athabasca deposit. The results provide data on the distribution of oil sands resources in the region and identify two subsurface valley systems that dominate sediment distribution. The central region of the Athabasca area is the second of a four-stage plan to consistently map the Athabasca oil sands area. The northern portion was completed in 1985 and the project now focuses on the southern portion of the area.

The Reservoir Analysis project continued to address the development and application of reservoir modelling techniques. Using numerical modelling and image analysis, researchers from the Oil Sands and Hydrocarbon Recovery Department and the Geological Survey Department are collaborating to quantify the significant decrease in both horizontal and vertical permeability caused by shale clasts located in the oil producing horizon.

Geological support for AOSTRA's Underground Test Facility (UTF) is the main priority for the Strategic Geology Program, funded by AOSTRA. The project is providing the parameters for building a detailed reservoir model. The Geological Survey continues to provide geological technical support to AOSTRA and its industry partners in a number of thermal pilot projects.

The Coal Geology program has completed two years of a three-year program jointly funded by Alberta





Energy and the Alberta Research Council. Detailed coal facies studies in the plains, sedimentology and structural studies in the mountains/foothills are well under way. This work is putting coal quality data in a geological framework in an attempt to create predictive models for coal quality variations that can be used for future industry development and exploration.

Environment

Water and Earth Resources

Work continued on a project, jointly funded by the Alberta Heritage Savings Trust Fund and the Alberta Research Council, to provide a scientific basis for development of guidelines for drilling-mud-solids disposal. Detailed sampling and characterization of wastes resulting from freshwater gel, invert and potassium chloride mud systems currently used in the Foothills region were undertaken to supplement similar work done previously in the Cold Lake region. Results of greenhouse experiments to assess changes in growth and trace element content of vegetation, as a function of different concentrations of wastes mixed with soil, have provided some guidance for determining landspreading rates.

In cooperation with ESSO Resources Canada Limited, the Alberta Research Council initiated a field experiment to assist in the definition of maximum or tolerable loading rates of various drilling wastes for operational disposal in the Cold Lake area.

A four-year study, sponsored by Suncor Inc. and the Alberta Research Council, to assess the feasibility of spreading a high-lime content sludge on land, was completed. Results indicate the sludge is acting as a soil liming agent and does not produce any deleterious effects to soil or crops.

The Alberta Research Council contributed to a major study of the Government/Industry Acid Deposition Research Program (ADRP) by demonstrating that regional scale impacts of acid deposition on soils are likely absent at present, but could occur in susceptible areas if large increases in deposition occur.

Peat and peatland classification, land use evaluation and environmental impacts of human use were investigated by analysis of chemical, physical and ecological attributes of these wetland systems. An evaluation of conventional and remote sensing methods for mapping peatlands was completed; a peatland distribution map of the province was published.

Land Reclamation

At the Smoky River Coal Limited site near Grande Cache, scientists found that native species will invade areas initially revegetated with agronomic species. This removes some of the concern associated with the previously perceived notion that long-term maintenance is required to maintain a self-sustaining cover. The work indicates that it may not be necessary nor desirable to maintain agronomic species in excess of five to eight years after initial revegetation. These results play an important role in the planning and implementation of materials handling and revegetation programs in the Foothills/Mountains region of Alberta.

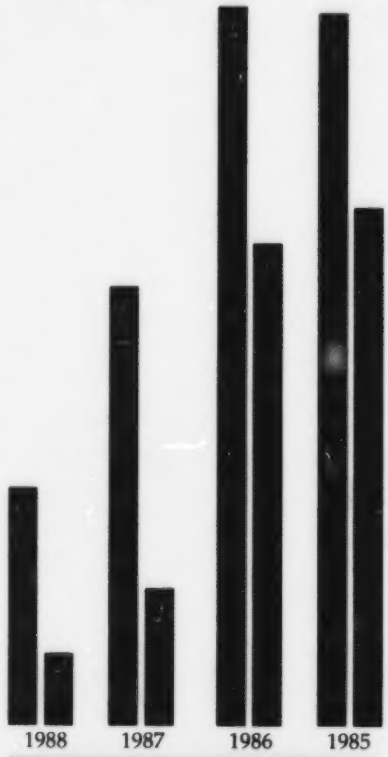
Extreme Weather

A memorandum of understanding has been signed by the Alberta Research Council, the University of Alberta, the Saskatchewan Research Council and Atmospheric Environment Service Canada, to undertake research and technology development aimed at providing better ways of forecasting, detecting and tracking severe weather events in the prairies.

Resource Technologies

■ Annual Expenditures
■ Contract Income

(Thousands of dollars)



The consortium's program is now under development. As a first step, the Alberta and Saskatchewan Research Councils will conduct a study to determine priorities for research and technology development efforts within this program.

SWIFT, a Severe Weather Intelligent Forecast Terminal, was delivered to the Atmospheric Environment Service in March 1988. SWIFT is a software system which forecasts the location and intensity of convection, based on traditional observations and forecasts, modified and enhanced by rules which embody the knowledge of an expert forecaster. The SWIFT forecasting technique was validated by comparison with observed data from days in 1987.

During the summer SWIFT was installed in the Alberta Weather Centre at the Atmospheric Environment Service offices in Edmonton. The forecasts produced by SWIFT were provided in the Alberta Weather Centre as an adjunct to the normal forecast process. The initial reaction to the quality of the forecasts has been positive.

A scientific consensus is emerging that the composition of the earth's atmosphere is changing due to industrial activities and that this is producing a global warming trend due to an increased 'greenhouse effect'. The Alberta government requires more detailed information on changes to be expected to regional climates, and also on the frequency and severity of extreme weather in order to develop strategies to adapt to climate change. The Resource Technologies Department has initiated a project aimed at collecting such information. The project is being supported by the Alberta Research Council, Alberta Agriculture, Alberta Environment, Alberta Forestry, Lands and Wildlife and Alberta Technology, Research and Telecommunications.

Air Quality

A joint project between the Alberta Research Council, Alberta Environment, and the Atmospheric Environment Service to compare and assess the overall operational performance of three mesoscale acid deposition models was completed. The study indicates that the different models produce different results, and existing data are not good enough to determine which model produces the most realistic results.

A project to investigate the role of dust in precipitation sampling was completed. The work was undertaken for a consortium of environmental departments in Alberta, Saskatchewan, British Columbia, Northwest Territories and Environment Canada.

Data Loggers

The Resource Technologies Department is designing and building two prototypes of a long-term data recording system for Alberta Forestry, Lands and Wildlife. These systems will record environmental information such as temperature, rainfall and possibly, ground temperatures in remote locations. It is anticipated that once the system is fully operational, each unit will require servicing only once a year. Initial plans call for some 40 of these units to be manufactured by an Alberta company under subcontract to the Alberta Research Council.

Industrial Assistance

The Resource Technologies Department completed user surveys as part of a sub-contract awarded by DIGIM, Inc. of Canada. These surveys assessed the needs of the Alberta petroleum industry for digital synthetic aperture radar images and its integration with existing geoscience data sets of the Canadian Geophysical Data Centre.

Small projects are also being conducted for Comeau and Associates, OEM Enterprises Ltd. and Alberta Government Telephones (AGT). OEM Enterprises requires assistance with the evaluation of techniques suitable for the electronic detection of an ice hockey puck at the goal line; AGT requires assistance in evaluating microwave multipath effects; and Comeau and Associates requires assistance in evaluating two down-hole-pump controllers.

Basin Analysis

The Alberta Research Council's Basin Analysis Group is a multidisciplinary team with expertise in various aspects of basin analysis including stratigraphy, sedimentology, hydrogeology, geothermics, geochemistry, numerical modelling of transport processes in porous media, and software development for handling large data bases.

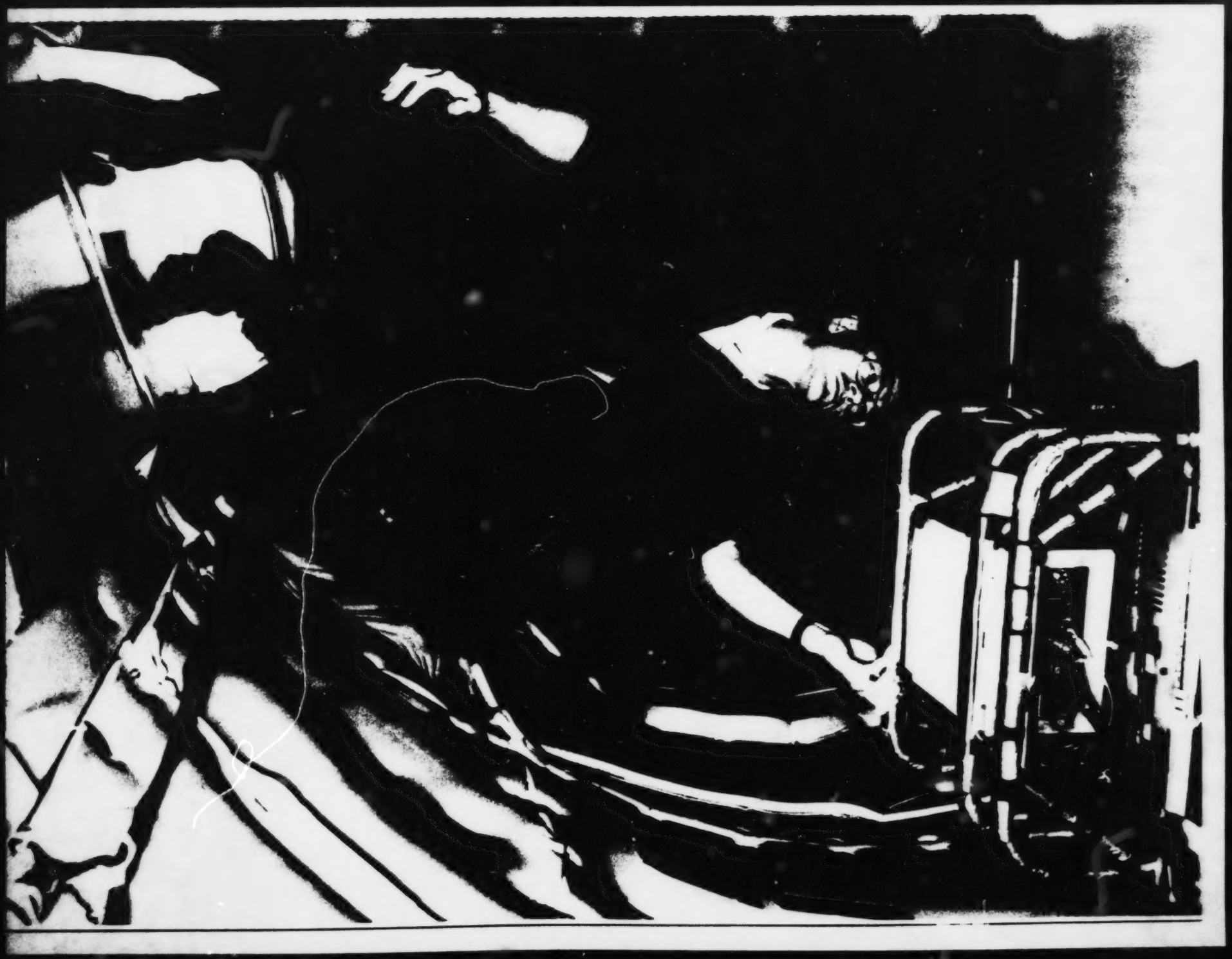
In cooperation with the Institute of Sedimentary and Petroleum Geology in Calgary, the Basin Analysis Group is carrying out a major study of the Peace River Arch. The project includes investigation of the effects of

the Peace River Arch on sedimentation, fluid flow, geothermal regime and oil and gas distribution in the region. Canadian Hunter has contributed a significant amount of digitized data.

Considerable progress has been made in defining the main phases of Arch development through seven distinct sedimentalogic and stratigraphic investigations. Efforts are now being directed to analysis of the present day hydrogeological and geothermal regimes as well as the development of models to aid in the prediction of hydrocarbon generation and migration scenarios in the region.

The Geological Atlas of the Western Canada Sedimentary Basin project will update the 1964 edition published by the Canadian Society of Petroleum Geologists. This complex endeavor involves more than 80 individuals from industry, government and universities. The Alberta Research Council, Alberta Energy and the Canadian Society of Petroleum Geologists have committed direct funding; digital data are being provided by the four western provinces; and volunteer manpower has been committed by oil companies, geological surveys and the Universities of Alberta, Calgary and Saskatchewan. A number of the important computing tasks have been completed and detailed cross sections across and along the basin have been constructed. The project will have two main products: a publicly available electronic data base of consistently interpreted information and a printed volume published by the Alberta Research Council and the Canadian Society of Petroleum Geologists. Completion date is March 1991.

Jiri Losert, seconded from Alberta Energy, interprets stratigraphy in regional cross sections through Alberta and Saskatchewan. The work is being done as part of the Atlas of the Western Canada Sedimentary Basin project.



Biotechnology

The Alberta Research Council operates one of North America's largest and most advanced facilities for scale up and process development of biotechnological fermentations. Now in its third year of operation, the biotechnology pilot plant continues to attract national and international attention and is uniquely placed to support the continued development of the biotechnology sector in Alberta.

The pilot plant, supported by first class laboratory facilities, is equipped with a wide range of fermentors and associated up- and down-stream processing facilities. The installation this year of a 15,000L fermentor and two more 7,500L fermentors, boosts fermentation capacity to more than 37,500L.

A major client is Biosys, a California-based biological pesticide company, whose technology for the use of entomogenous nematodes in agricultural and garden pest control has been developed and refined by Alberta Research Council scientists. These nematodes offer a natural biological alternative to the use of chemical pesticides; they are naturally occurring soil organisms and impose no environmental burden on the biosphere. Interim production of nematodes on behalf of Biosys is being carried out at the Alberta Research Council until the company is able to complete its own production facilities in Alberta.

The Alberta Research Council is conducting scale up and pre-production manufacture for Philom Bios Inc., Saskatoon, Saskatchewan, of an herbicide and fertilizer enhancer, based on the use of natural fungi. The product, BioMal, used to combat round-leaved mallow, a serious threat to cultivated crops, was being field tested in 1988.

Other clients are drawn from a wide spectrum of companies, from major multinational corporations to small start-up entrepreneurial firms. Development projects are based on the exploitation of several aspects of biological technologies, ranging from further applications of agricultural biotechnology through to pharmaceuticals. Novel methods for improving agriculturally important crops through techniques of protoplast fusion, strategies for the utilization of agricultural and other waste materials were also under investigation by the department. Improved strategies for the purification of high value products and of microbes and microbiological techniques for enhancing the nitrogen-fixing capabilities of legumes is supported by a grant from Alberta Agriculture's Farming for the Future program, and includes work designed to scale up the processes.

The department is involved in biotechnological research in a microgravity environment, and a department bioscientist has carried out several experiments on bubble formation in bioreactors, while flying at near zero gravity in specially adapted aircraft. In its space biotechnology program, the Alberta Research Council has collaborated with the National Research Council Space Division, SED Systems Ltd. of Saskatoon, SciCan (an Edmonton biotechnology company), and the National Aeronautics and Space Administration (NASA), Houston, Texas.

Dr. Brad Thompson in free fall during microgravity experiments aboard NASA KC-135 aircraft.

Agriculture

Soil and Water

The loss of productive farmland due to soil salinization and soil erosion is a serious concern in the agricultural community.

Soil salinity research is driven by the desire to identify and rectify practices that may be contributing to the increase in salinized acreage. The close association between shallow water-table conditions and soil salinity along the margins of lower-slope depressions has been established.

At several sites in east-central and southern Alberta, research is proceeding to establish the link between upland sources of groundwater recharge and soil salinity in lower-slope positions. Research activities have been supported by Alberta Agriculture, Farming for the Future, the Prairie Farm Rehabilitation Administration and Agriculture Canada.

Microbiology

In the microbiology laboratory, work in biosynthesis of branched-chain fatty acids has resulted in the identification of a decarboxylase, an enzyme necessary for the genetic manipulation of a plant's lipid system, which could lead to development of cold-hardy crops. The enzyme has been purified, its protein sequence determined and the antibody against it has been produced in the laboratory. These results are being used to clone the gene encoding this enzyme.

Soil scientists Laurence Andriashek and Dr. Steve Moran measure thickness of beds in Belly River sandstone.

Forestry

In November the Alberta Research Council announced the formation of a forestry department, incorporating the existing Forest Products Program, and expanding the scope of research and development to support one of Alberta's key renewable resource industries. The new department, which will be guided by an industry/government policy and program committee, will encompass technology applications which can improve forest sector profitability.

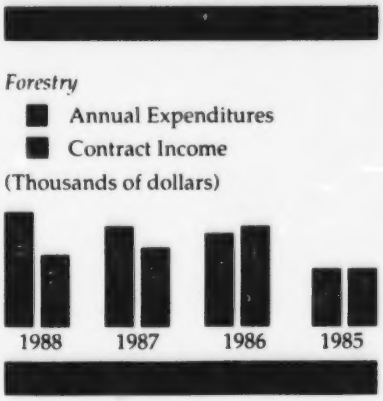
The Forest Products Program concentrates on engineered wood composites made from Alberta aspen, provides contract services to private industry, and carries out pilot work in new areas of forest products technology. As in previous years, the mainstay of the program's research, development and testing activities was provided through C/AFRDA (Canada/Alberta Forest Resource Development Agreement), jointly supported by Alberta Forestry, Lands and Wildlife, and the Canadian Forest Service. In 1988, this fund accounted for the major share of contract revenue, and for further investment in capital equipment.

Forest products testing and panel development contracts were carried out for industry, including CMHC certifications tests for two new oriented strandboard(OSB) mills and a variety of new product developments.

Standards Council of Canada accreditation of the Testing Laboratory was extended. The Testing Laboratory increased its capability to cover three new CSA standards for evaluation of waferboard/OSB. Participation in drafting of new CSA Codes on Panel Performance resulted in the inclusion of two test methods developed by the Alberta Research Council: full sized panel machine stress rating and creep testing.

A cross certification agreement was signed with the American Plywood Association. The agreement allows the Alberta Research Council to perform U.S. standards tests, and the American Plywood Association to perform Canadian standards tests on forest products destined for export.

The initiative aimed at assisting exports of Canadian waferboard/OSB to Japan continued. A visit was made to Japanese testing laboratories and a submission has been prepared to have the forest products laboratory cited as a "designated foreign testing body" to Japan.



A beam tester and a wall racking device were fabricated and installed. The Panel Development Laboratory has upgraded its facilities to include a laboratory scale waferizer.

One patent was granted – "Transverse Vibration Apparatus for Grading Wood Panels" (U.S. #4,722,223 of February 2, 1988).

A new low-profile and a high-profile, flat top waveboard was developed. Waveboard™ is a new, third generation corrugated waferboard developed under the Forest Products Program, which has demonstrated greatly improved stiffness/weight and strength/weight ratios over comparable flat board. Considerable Canadian and international interest has been shown in waveboard development, including various structural applications, finishing waveboard with veneer, and insulation.

Experimental (binderless) panels were made of exploded bark wood wastes. These new panels exhibited high internal bond. The novelty of this finding is presently being explored.

In the Forest Products testing laboratory, technician David Bilyk prepares oriented strandboard for static bending

Natural Resources

Geographic Information Systems (GIS)

Alberta Research Council staff and private sector consultants are working with Forest Management Agreement (FMA) holders to identify land-related data important to Alberta forestry operations. Technical aspects of GIS implementation are being evaluated, including the identification of information handling processes, distribution standards, data requirements for support of forest management applications, as well as system requirements and costs. Results will be used to look at opportunities for collective effort in the definition and building of forestry data sets and identification of common research needs.

A pilot project is under way using GIS technology to integrate data from several different sources into a model for predicting the distribution of low strength overburden that is subject to potential highwall failures. Data from aerial photo interpretations, surface geophysical investigations, borehole geophysical logs and core data will be combined in a computer data base that will permit ready access to both data and interpretive models.

Land Resources

The multidisciplinary resource inventory of the County of Flagstaff was completed and has become a model in building a uniform intermediate-scale, soils data base for agricultural counties in Alberta. It also has expanded cooperation between the

John Pawlowicz examines cuttings from a rotary drilling rig during coal exploration.

Alberta Research Council, Agriculture Canada and Alberta Environment. The land resource inventory of the County of St. Paul continues with approximately three quarters of the county mapped.

Four projects involving regional mapping and study of the Quaternary stratigraphy, essential for effective land use planning, agriculture and resource development, are at or nearing completion. They are: Quaternary stratigraphy of the Edmonton area; a three-dimensional overview of the entire Quaternary sequence; Quaternary geology of the Sand River map area, which describes the three-dimensional distribution of the sediment; southern Alberta Quaternary geology, which integrates the mapping synthesis with lithoanalysis of subsurface data; and, Quaternary geology of the Vermilion map area, a description of the surficial sediment and stratigraphic framework.

Coal Development

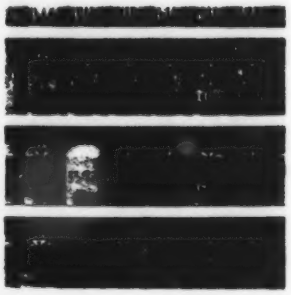
The terrain sciences research team focused on projects jointly funded by coal producers, geotechnical companies, the Alberta Research Council, the Alberta Office of Coal Research and Technology and CANMET in surface geophysics, downhole geophysics, and highwall stability to improve the economic viability of plains coal exploration and mine planning.

Surface geophysics activity, initiated to demonstrate the cost- effectiveness of applying surface geophysical techniques in locating and defining specific coal mine planning and exploration targets, concluded that integration of surface geophysical techniques with geological surface mapping and a drilling program is a cost-effective approach to coal mine exploration and planning.

Mineral Resources

Tertiary gravels are a valuable resource, representing one third of Alberta's mineral aggregate, and form many large aquifers. In 1988 the Mineral Resources Group, under the Alberta Geological Survey, initiated a program to characterize the Tertiary gravel deposits of Alberta in terms of their mineral composition, geologic origin and economic potential. Two major field studies to explore for aggregate deposits were undertaken for Alberta Forestry, Lands and Wildlife and Alberta Transportation and Utilities. These funding agencies need an inventory of local gravel deposits: east of Peace River to build the infrastructure to support a new pulp operation, and in the Wandering River area for new access road development to Fort McMurray.

The Mineral Resources Group is also responsible for operation of the Mineral Core Research Facility (MCRF), jointly funded by Alberta Energy and the Alberta Research Council. The MCRF collects metallic mineral exploration data and makes this information available to industry, under the terms of Alberta's Metallic Minerals Regulations. Included in this data is representative drill core from metallic minerals exploration in Alberta. At present the facility contains core from more than 25,000 metres of exploration drill core, the bulk of which is available for public examination.



Transportation

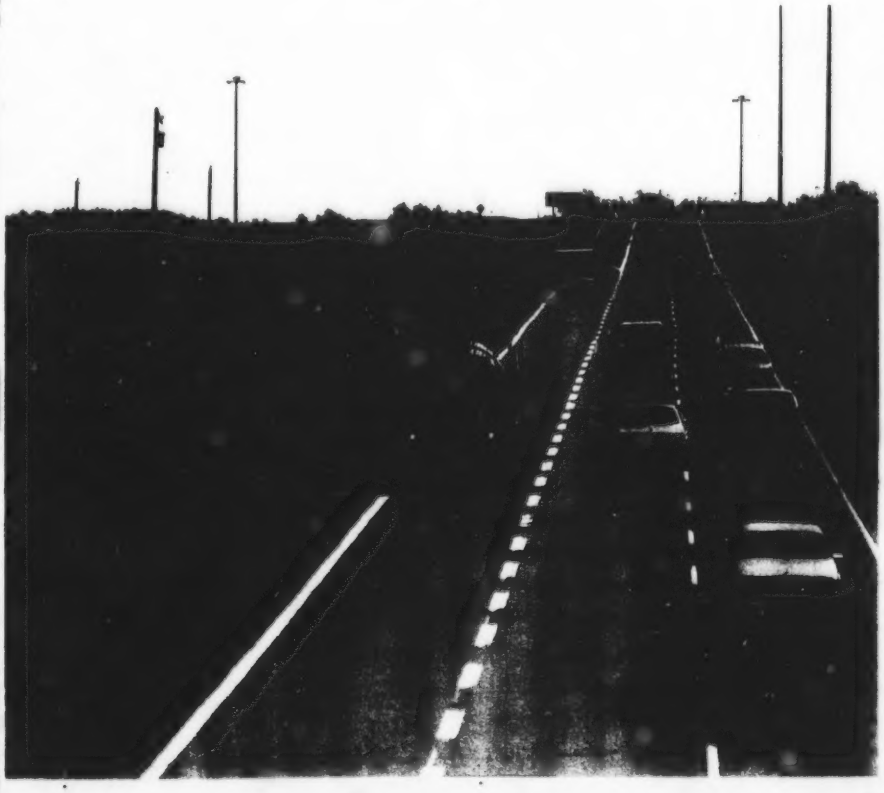
The Canadian Strategic Highway Research Program(C-SHRP) has been initiated to address major concerns of transportation agencies across Canada. The effects of structural, traffic and environmental factors on pavement service life is one of the important issues being considered by C-SHRP. The Alberta Research Council has developed site selection criteria and has assisted in the design of a national field monitoring program to determine the effects of various rehabilitation strategies for long-term pavement performance. Alberta Transportation and Utilities provides support to C-SHRP.

The unique technology in instrumentation and monitoring pavement response to traffic loads developed by the Alberta Research Council is being transferred to Canadian universities to facilitate current pavement response/vehicle load field studies. In addition, this technology is being employed in a major United States Federal Highway Administration project.

Alberta Transportation and Utilities is constructing a highway overpass over the railway right-of-way at Obed. The Alberta Research Council is designing and installing instrumentation to measure and record stresses and strains within the structure during and following construction.

Alberta's pavement management system, developed in part by the Alberta Research Council, models the current and future pavement condition of the provincial highway network and is used for planning rehabilitation priorities. Detailed pavement condition surveys and subjective surface condition ratings have been carried out on selected highway sections throughout the province. The results of the two types of field investigations are being correlated to develop an improved condition rating system resulting in enhanced performance prediction models.

Pavement strength varies throughout the year and, in general, is weakest during spring thaw. In order to minimize pavement damage during this period, vehicle weight allowances are reduced on much of the provincial highway system. The magnitude and duration of these spring load bans is important to both the province and the trucking industry. The Alberta Research Council is cur-



Traffic and the environment affect pavement service life. The Research Council has helped design a national field monitoring program to address these factors.

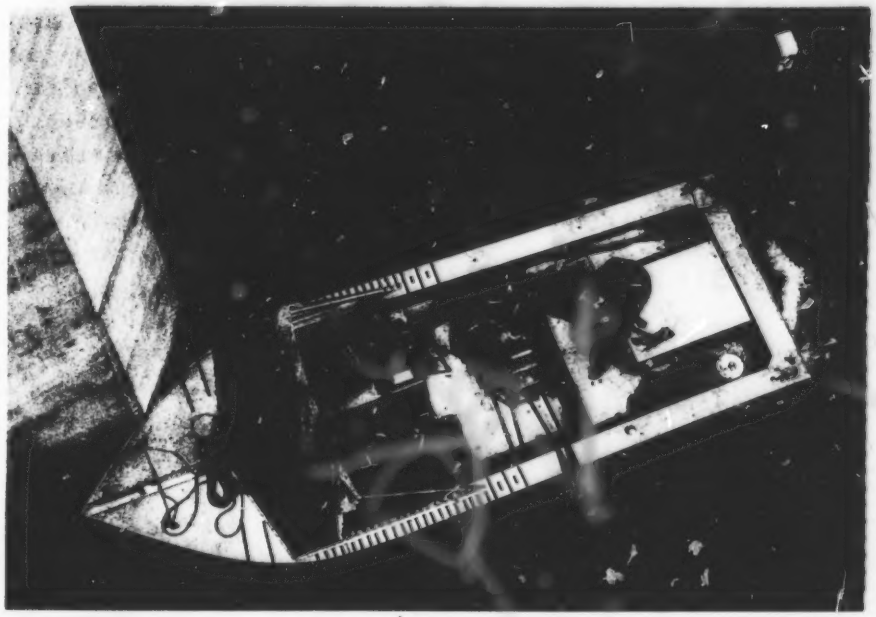
rently analyzing seasonal pavement strength data from more than 4000 field measurements taken throughout the province. An effort to accurately quantify the variations is expected to lead to the development of optimal spring load ban criteria.

Surface Water Engineering

The intent of the Cooperative Research Program in Surface Water Engineering – a partnership of Alberta Transportation and Utilities, Alberta Environment, and the Alberta Research Council – is to strengthen the technology being applied to the management and development of Alberta's surface water resources.

This year, ongoing flood and scour studies on sand-bed rivers have been completed for the lower Red Deer, Beaver, Battle, and Swan rivers. A report describing and analyzing measurements of scour and related hydraulic characteristics, carried out during the 1986 flood on the Pembina River, also was completed. The focus will now shift to gravel-bed rivers, with the North Saskatchewan River at Berrymore having the highest priority. In addition, ten new Water Survey of Canada gauge sites, not tabulated in the 1972 publication, Hydraulic and Geomorphic Characteristics of Rivers in Alberta, have been analyzed and published in a new expanded format.

With the curtailing of ice load measurements on selected Alberta rivers, attention is being directed towards improving the estimates of likely ice loads on all rivers. A study to establish regional criteria for quantifying ice loads has been completed. Work has continued on the breakup observations on the Athabasca River, with the reporting of the 1986 and 1987 ice jam measurements at Fort McMurray. A numerical technique was developed to predict the time of spring breakup. This procedure will allow resource managers to estimate objectively the time of breakup on the Athabasca River, using readily available meteorologic and hydrologic information.



Surface water team takes soundings to assess bridge pier scour.

In the area of hydrology, a study which examines the regionalization of floods has been completed for the North Saskatchewan River basin. This provides for a simple, more confident evaluation of flood peaks based on the physiographic characteristics of basins for which no runoff records exist. This study is currently being focused on the Red Deer River basin.

The group's traditional expertise in dispersion measurements has been applied to water quality concerns on the Athabasca and South Saskatchewan Rivers. Assistance was given to the private sector through the use of water quality probes and logging devices that could operate in a remote and severe environment.

Industrial Assistance

The Alberta Research Council administers the Industrial Research Assistance Program (IRAP) in Alberta for the National Research Council. In 1988, more than $3.8 million in IRAP funding was dispensed to small- and medium-size companies, enabling them to undertake innovative projects they otherwise could not afford to do.

An Industrial Technology Advisor Network, which includes Alberta Research Council technology field advisors, is accessible through the Alberta Research Council's offices in Edmonton, Calgary, Lethbridge, Medicine Hat, and for the first time, in Red Deer. With IRAP support and the expertise available at the Alberta Research Council, entrepreneurs, inventors and companies are bringing creative new processes or products to market. Here are summaries of four examples:

A portable unit for reclaiming gas treating chemicals. – This one-of-a-kind process plant was developed and patented by Canadian Chemical Reclaiming Ltd., Brooks, Alberta, with the help of the Alberta Research Council's industrial development group and two IRAP grants. In this case, the Research Council was able to bring together the company's president, Tod Beasly, with Camtech Design Edmonton Ltd., and Merritt Engineering Ltd., Calgary, the companies which contributed to the successful design of the unit. The equipment has operated at three major natural gas plants and has a committed workload for the foreseeable future. It is saving the gas industry money and providing a pollution deterrent.

Cultured marble domestic countertops.– A small Edmonton company, Intercontinental Marble Corporation of Canada Ltd., has introduced into the market its product line in competition with North American and Japanese companies. Behind the development of CANDORA (R) is a two-year association between the company's president, Steve Katyal, his seven employees, and the Alberta Research Council. A large amount of information and technology has been transferred to the company by Industrial Development and the Research Council's Industrial Services Laboratory (ISL). ISL continues to provide final testing for the product.

Spray on Tracing Agent. – This ingenious product, for use by graphics and draftspersons, was developed by an Edmonton entrepreneur, Ron Varze, out of his own experience in visual arts. Having experimented with applying graphite to drawings by using an airbrush, Mr. Varze had his concept for a spray-on applicator. What he needed was a workable formula and he turned to the Alberta Research Council. Again, IRAP funding was obtained, and the ISL staff undertook the formulation development and testing trials. Spray on Tracing Agent is being marketed by Letraset, and was on local store shelves in November, 1988.

Industrial Services Laboratory staff Dr. Ed Bertram and Dale Wascherol watch as Don Cicchino, Exxon Research, New Jersey, and John Aumuller, Esso Petroleum Canada, examine refractory panels tested for catalytic cracker at Esso's Strathcona refinery.

Peat moss golf tees. – This invention is just the beginning for entrepreneur Don Noland. The idea for a golf tee, which will turn to mulch if broken, brought Mr. Noland to the Alberta Research Council for help in developing his product. His ingenuity, the IRAP support and ISL's work helped launch a prototype which grabbed instant attention from the sports world. It is also leading to other peat moss products, including a peat seedling container which can be injected into the earth by a pressure gun, for use in reforestation; and peat pigeons to replace the clay pigeons used in trap shooting.

Materials and Testing

The Industrial Services Laboratory (ISL) continued to provide testing services to more than 100 small- and medium-sized Alberta companies during the year. A multidisciplinary approach to problem solving is one of the hallmarks of the ISL. The type and amount of work to be performed is client-driven, and involves comprehensive meetings with the customer to set objectives of the research. This ensures that the most cost effective approach and solution will be provided.

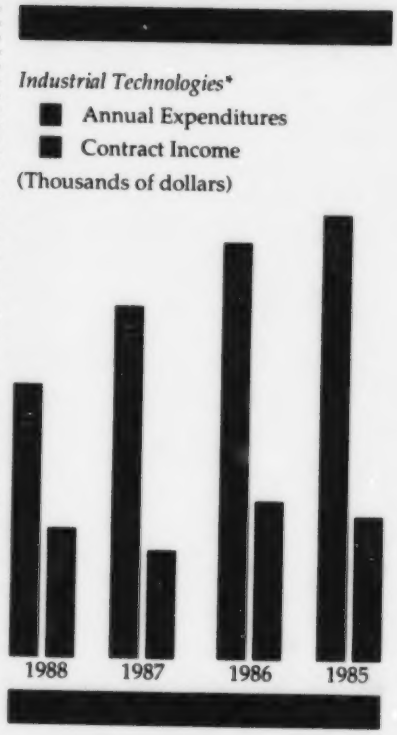
In 1988, the laboratory was accepted by the Canadian General Standards Board as a testing facility for vapour barrier polyethylene sheet, insulation products and canola oil packaging. Other projects included pesticide-coated canola seeds and testing of materials for component selection in telephones, and polymer films.

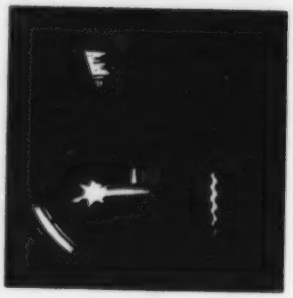
The Gas Processing group continued to provide technical support to International Permeation Inc. on the development and commercialization of membrane permeation processes for gas separation. Highlights in 1988 include a commercial membrane installation for carbon dioxide separation from natural gas, and improvement of permeation processes for gas mixtures containing hydrocarbon liquids.

The Advanced Materials Laboratory, still in an evolutionary stage, was involved in design and application of wear and corrosion resistant advanced ceramic coatings by vacuum-assisted plasma spray technology. Staff also participated in a Technology Awareness Mission on Advanced Ceramics to Europe sponsored by the Department of External Affairs' Technology Inflow Program (TIP).

Work continued in the Analytical Chemistry Laboratory on the development and applications of a gas chromatography/mass spectrometric method of identifying compound classes in complex hyrdocarbon mixtures. Specialized analyses were conducted for industrial clients to assist in identifying materials and diagnosing process and manufacturing problems.

During the year, the Gasoline and Oil Testing Laboratory published winter and summer surveys of the characteristics of automotive gasoline and diesel fuels across Canada. The laboratory also conducted its first annual course on the operation and maintenance of octane and cetane rating engines and hosted the American Society for Testing and Materials (ASTM) Rocky Mountain Region meeting on the testing of automobile gasolines.





* Now Materials and Testing department under reorganization December 1988.

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Advanced Technologies

The Advanced Technologies Department, located in Calgary, serves Alberta industry through technology transfer and contract research activities in the areas of advanced computing and advanced engineering. In particular, the expertise of the department is concentrated in technologies related to artificial intelligence, knowledge-based systems, robotics and automation in manufacturing.

Under its core research program, the department has developed conceptualization and design of a Process Planner II, a multi-discipline artificial intelligence project concerned with the specification, planning and execution of changes in physical systems involving time. The Process Planner II is aimed at providing process engineers with an intelligent tool for use in the manufacturing industry.

The Advanced Technologies Department carried out much of the work for the Joint Research Venture Program during 1988: staff were involved in eight joint research venture projects. The Alberta Research Council and Computer Based Training Systems Ltd. have developed sophisticated software designed to run on microcomputers, which will serve as a multi-purpose, flexible learning tool for use by teachers and students from primary school to university, and in industrial on-the-job training programs. For teachers, the system offers a curriculum development component that acts as a teacher's personal expert in instructional design. Another part of the system administers and marks a variety of tests and accepts answers to be marked by the teacher. Because the system tracks each student, it can advise teachers on the best way to present a particular subject. The system is ready to be demonstrated to Alberta Education, which has expressed considerable interest in the project.

Through its decision to have a part in the Canadian Space Program, the Alberta Research Council has encouraged and supported private industry bids on space work contracts. Four proposals put forward, with the Alberta Research Council named as a subcontractor, have received approval. Two contracts, dealing with an artificial intelligence application and building of a prototype expert system for health monitoring of the Mobile Space Station, have been signed. The Alberta Research Council is also working with SED Systems Inc., Saskatoon, in developing a generic diagnostic system for satellites, which will have an artificial intelligence application.

The Alberta Research Council and the National Research Council are jointly establishing a laboratory for the development of expert systems in construction. This activity is complementary to the creation of the Alberta Construction Technology Centre, and the appointment of four NRC construction technology field advisors in Alberta, one of whom is situated within the Advanced Technologies Department.

Project engineer Keith Chrystall watches Standen's new robot going through its paces. **(See page 28)**

On a national scale, the Advanced Technologies Department is the largest applied research group in artificial intelligence and robotics. It serves the community by editing and publishing the trade journal Canadian AI, which represents the Canadian artificial intelligence community through the Canadian Society for Computational Studies of Intelligence (CSCSI), a sub-organization of CIPS, the Canadian Information Processing Society.

Joint Research Venture Program

Each year, Alberta companies have the potential to bring innovative new products, processes and services to the marketplace. For small- to medium-size firms, however, lack of sufficient funding or technical expertise can prevent this potential from being realized. The Joint Research Venture Program is an Alberta Research Council initiative designed to help bridge this gap. By sharing its resources with selected industry co-venturers, the Research Council fulfills its mandate to stimulate Alberta industry. At the same time, participating companies have an opportunity to share the costs and work involved in taking their innovative and marketable technology to a commercial stage.

The Joint Research Venture Program has firmly established the Alberta Research Council's commitment to working with the private sector and has been highly successful in transferring knowledge, experience and skills directly into small- and medium-size industries. Eight projects have been completed and another 12 are under way.

These include the design and installation of an automated work cell for Standen's Limited, a Calgary manufacturer of automotive springs. In November, Standen's officially marked the installation of the automation system which will boost the company's competitive edge in the international marketplace. The project represents the first use of a six-axis robot in the industrial workplace in Alberta, and one of the few applications of robotics in a metal foundry. Benefits are reduction of risk to the human worker as well as improving Standen's productivity.

The technology developed under a joint research venture with PSI Energy Software Ltd. has resulted in the establishment of a new company, Calgary-based ECLIPSS. The company has been formed by PSI and C.O. Nickle Publications to develop and market POGOPLUS, software that combines up-to-the-minute energy data with sophisticated economic analysis for use by oil and gas companies.

A new joint research venture has been started this year with Pulsearch Consolidated Technology Limited, Calgary, to develop an inertial pig sensor system for determining the profile, ovality and displacement of oil and gas pipelines. Deformation monitoring of oil and gas pipelines is essential to forecasting integrity changes which allow corrective measures to be taken before actual pipeline failure occurs.

HEP Pumping Systems, a division of Canadian Foremost of Calgary, is working on a joint research venture with the Oil Sands and Hydrocarbon Recovery and Advanced Technologies departments to develop a microcomputer-based controller for HEP Pumping Systems. The digital controller will replace the present analog controllers. The primary objective is to obtain a more reliable pumping system with more flexible and enhanced control through the use of adaptive techniques, and which will have a capability for expansion into areas such as remote communications and Pump Off Control.

Chris Prince, foreground and Ruby Loo, right, from the Research Council's Advanced Technologies Department, with Nicholas Rushton, general manager, operations, Pulsearch Consolidated Technologies, and the first prototype of an inertial pig being constructed under a joint research venture.

Electronics Test Centre

The Electronics Test Centre continues to improve the competitive position of Alberta electronic companies by helping them achieve the certifications and approvals necessary to market their products on a worldwide basis. Under its mandate, the Test Centre provides guidance, advice and assistance to Alberta manufacturers. In 1988, the Electronics Test Centre performed work on 295 projects. In three years of operation, the Test Centre has handled 834 projects from 458 companies. Of these, 247 are Alberta-based companies. Projected revenues for 1988 totalling $600,000 indicate a 35 per cent increase over last year.

The Test Centre passed its first audit conducted by the Department of National Defence (DND) and the Standards Council of Canada. In 1988, the Test Centre performed EMI (electromagnetic interference) tests, environmental tests, and product integrity evaluation for seven clients subcontracted to the Canadian Frigate Program. Testing was also performed for three client subcontractors to DND's Low Level Air Defence contract.

The Test Centre is experiencing a marked increase in EMI and product integrity testing business, consistent with testing for the departments of National Defence, Transport and Communications. A future increase in EMI business is being forecast when EMI testing becomes mandatory in Canada on January 1, 1989.

Electromagnetic interference emissions tests on new electronic products are conducted in the Electronics Test Centre's anechoic chamber. Dale Kisilevich checks the EMI equipment.

Information Centres

The Alberta Research Council maintains information centres for the benefit of industry, government, the general public, as well as its own staff.

Alberta Waste Materials Exchange

Alberta industry has an outlet for improved waste management practices and an alternative to waste disposal through the Alberta Waste Materials Exchange (AWME), funded by Alberta Environment. The Alberta Research Council operates the AWME as an information clearinghouse designed to put potential users of waste materials in contact with waste producers. AWME publishes a bi-monthly exchange bulletin.

In 1988, there were 452 listings representing materials available, wanted and environmental services provided by industry. A U.S. firm, through the AWME, found two Alberta companies that had large quantities of high quality paper from document destruction which it could market to Pacific Rim countries. The quantity of paper is 10 to 15 containers per month, at approximately 19 tonnes per container.

Industrial Information

Industrial Information Services in both Edmonton and Calgary provide industry with access to most of the world's published scientific and technical literature, perform patent searches and voice/data conferencing.

In 1988, Industrial Information carried out close to 2600 online searches for Research Council technology advisors and industrial clients. From the search results, more than 3300 documents were ordered and delivered to clients.

Information Geology

Information Geology manages GEODIAL, the provincial data base and contributes geological information to GEOSCAN, the national data base. Information Geology handles an average of 500 calls annually.

AOSTRA Library and Information Services

The Alberta Research Council manages the AOSTRA Library and Information Services (ALIS), the central source for all published information on oil sands, heavy oil, and selected publications on enhanced recovery processes. ALIS, which has locations in Edmonton and Calgary, is funded by AOSTRA.

Electronic Industry Information System

The Electronic Industry Information System (EIIS) has been consolidated under the Advanced Technologies Department. EIIS was set up as a pilot project to provide an electronic messaging service and proprietary data base developed specifically for Alberta industry. Having completed the pilot in March, the EIIS is currently under review.

Donna Wauters, Industrial Information, Calgary, examines online search material.

International Activity

Through its scientific network the Alberta Research Council develops and promotes staff exchanges with other research institutes. These ties are becoming more important as Alberta expands its international commerce. Some of this year's activity is outlined here:

Oil sands. The Alberta Research Council is recognized internationally for its expertise and research in heavy oil recovery. In 1987 with World Bank funding, the Alberta Research Council undertook initial work to help develop Indonesia's asbuton deposit for road paving. Subsequently, a contract with the Indonesian government has been signed and Research Council geologists and oil sands researchers are in Indonesia working on the project.

Cooperative research programs with the Peoples' Republic of China expanded in 1988 with scientists from RIPED and the Chinese Academy of Science spending up to one year in the laboratories of the Alberta Research Council. Research Council staff in turn spent six weeks lecturing in China.

Coal. The aim of a coal/oil co-processing program at the Coal Research Centre Devon is to simultaneously convert low quality hydrocarbon feedstocks, such as Alberta subbituminous coal and high sulfur resids (Athabasca, Cold Lake), into high value transportation and heating fuels. This jointly funded project has drawn sponsors from three continents: North America (U.S. Department of Energy, the Electric Power Research Institute and Hydrocarbon Research Inc.); Asia (Mitsui SRC Development Co. Ltd.) and Europe (Ruhrkohle Oel Und Gas GMBH).

The Alberta Research Council acted as project manager for the Alberta Office of Coal Research Technology in a coal combustion research program at the International Flame Research Foundation, Netherlands which is jointly funded by Canada, the Netherlands, and West Germany. Three Alberta coals have been included in the test program.

Geology. The government of Jordan is undertaking a major assessment of the country's energy resources, and the Alberta Research Council, in cooperation with Petro-Canada International Assistance Corporation and AOSTRA, is providing technical advice to the Jordanian Ministry of Energy.

Ceramics. An Alberta Geological Survey study, supported by the International Development Research Centre, is establishing the distribution, mineralogy, chemical and ceramic properties of the abundant coastal clays of Guyana. Personnel of the Guyana Geology and Mines Commission and of the Institute of Applied Science and Technology are being trained in ceramics research. A drilling and testing program established for 21 geographically widespread sites on the Demerara and Coropina coastal clays has yielded valuable data for characterizing their ceramic properties.

Geographic Information Systems. As part of the Alberta/China scientific exchange program coordinated by Alberta Technology, Research and Telecommunications, the Heilongjiang Academy of Sciences in Harbin and the Alberta Research Council have undertaken a project to develop a computer system for land use planning, specifically for agricultural development. A visiting scientist from Harbin is in Edmonton working with Alberta Research Council staff to develop the land information system for the study area, Bin County.

Geologist John Kramers in Indonesia.

Forest Products. An Australian forest products manufacturer sent a shipment of Australian slash and hoop pine veneer to the Alberta Research Council for experimental application to waveboard and waveply. The Research Council was successful in making waveboard from an Alberta aspen wafer core with Australian pine veneer facing.

Biotechnology. The Alberta Research Council and the Municipality of Wuhan, Hubei Province in China, have signed a letter of intent as an initial step to the establishment of scale up and production facilities aimed at servicing the Chinese market.

People – Our Most Important Resource

The Alberta Research Council is fortunate in the scope of its physical facilities, but all the bricks and mortar, well-equipped laboratories and offices, would be as nothing without the human element. Our staff are, indeed, our most important resource – it is their capability and their commitment, together with their record of achievement, which has earned for the Alberta Research Council its outstanding reputation.

To demonstrate what the Research Council is all about, an annual awards ceremony, to recognize outstanding achievements by staff, was initiated in 1988. The following is a list of those awards winners:

Don Macdonald and Rudy Strobl, receive congratulations from Dr. Duncan Currie for best paper award.

Patents:

Dr. Lars Bach, manager, Forest Products Laboratories: U.S. Patent, November 1987, "Transverse Vibration Apparatus for Grading Wood Panels"; and U.S. Patent, June 1987, "Process for the Manufacture of a Corrugated Wafer Board Panel."

Dr. Leszek Ignasiak, project manager, Agglomeration Group, Coal and Hydrocarbon Processing Department: Canadian Patent, 1986, U.S. Patent January, 1987, "Agglomeration of Subbituminous Coal Fines".

Dr. Duncan Currie, vice-president, Development and Planning: Canadian Patent, January 1987, "Oil Sands Mining".

Best Paper:

Don Macdonald and Rudy Strobl, Alberta Geological Survey: "Coals Formed in Coastal Environments Within the Upper Cretaceous of the Alberta Basin" – presented at the American Association of Petroleum Geologists meeting, Boise, Idaho.

Invited Lecturer:

Dr. Grant Mossop, Alberta Geological Survey, keynote speaker at the Geological Society of America Penrose Conference on Geopolitics, Steamboat Springs, Colorado, July, 1987; and "Geological History of the Western Canada Sedimentary Basin" – Distinguished Lecture of the Canadian Society of Petroleum Geologists, presented at 11 Canadian universities.

External Professional Awards:

Dr. Rand Harrison, Alberta Geological Survey (on secondment to Alberta Technology, Research and Telecommunications): 1987 Canadian Society of Petroleum Geologists Tracks Award.

Dr. Peter Tremaine, Oil Sands and Hydrocarbon Recovery Department: 1987 Sunner Award for contributions to the development of new calorimetric methods, or the novel application of existing methods to problems in science or engineering, presented at the annual Calorimetry Conference, Boulder, Colorado.

Long Term Service (25 years):

Ron Wasel, chief chemist, Gasoline and Oil Testing Laboratory.
Don Morrison, systems analyst, Oil Sands and Hydrocarbon Recovery Department.

Senior Level Promotions:

Oil Sands and Hydrocarbon Recovery Department:
Dr. Bill Gunter to senior research officer;
Dr. Eddy Isaacs to senior research officer;
Lina Klein to technologist IV;
Dale Hoover to technologist IV;
Gerard Korpany to technologist IV;
Gurdeep Purewal to technologist IV.
Coal and Hyrdocarbon Processing Department:
Peter Mohammed to technologist IV.

Auditor's Report

To the Board of Directors of the Alberta Research Council

I have examined the balance sheet of the Alberta Research Council as at March 31, 1988 and the statement of revenue, expenditure and equity for the year then ended. My examination was made in accordance with generally accepted auditing standards, and accordingly included such tests and other procedures as I considered necessary in the circumstances.

In my opinion, these financial statements present fairly the financial position of the Council as at March 31, 1988 and the results of its operations and the changes in its financial position for the year then ended in accordance with the disclosed basis of accounting, considered appropriate in the circumstances, as described in Note 2 to the financial statements applied on a basis consistent with that of the preceding year.

Donald D. Salmon

C.A.
Auditor General

Edmonton, Alberta
June 30, 1988

Alberta Research Council

Balance Sheet

as at March 31, 1988 (thousands of dollars)

	1988	1987		1988	1987
Assets			***Liabilities and Equity***		
Current:			*Current:*		
Cash	$ 9,576	$ 9,618	Accounts payable	$ 3,259	$ 4,269
Accounts receivable	5,081	3,514	Unearned contract revenue	3,210	2,384
Accrued income receivable	2,382	1,922	Promissory note payable (Note 4)	200	200
Prepaid expenses	167	45	Obligation under capital lease (Note 6)	549	502
Advances to joint research ventures	620	410			
Current portion – deferred pension costs (Note 3)	57	–			
	17,883	15,509		7,218	7,355
Non-current:			*Non-current:*		
Investment in limited partnership (Note 4)	200	200	Unearned contract revenue	568	1,230
Deferred pension costs (Note 3)	287	–	Obligation under capital lease (Note 6)	544	1,093
	487	200		1,112	2,323
Fixed:			*Equity:*		
Equipment (Note 5)	48,442	43,717	Fixed assets (Note 7)	47,349	42,122
			Operating	3,740	2,354
			Special purpose, Schedule 1	7,393	5,272
				58,482	49,748
	66,812	59,426		66,812	59,426
Trust Fund:			*Trust Fund:*		
Cash	74	116	Liability	74	116
	$66,886	$59,542		$66,886	$59,542

The accompanying notes are part of these financial statements.

Alberta Research Council

Statement of Revenue, Expenditure and Equity

for the year ended March 31, 1988 (thousands of dollars)

	Operating	Special Purpose (Schedule 1)	Total 1988	Total 1987
Revenue				
Grants from Province of Alberta:				
General Revenue Fund	$17,550	$7,997	$25,547	$22,830
Alberta Heritage Savings Trust Fund	–	–	–	565
	17,550	7,997	25,547	23,395
Contract Revenue:				
Provincial Government departments and agencies	8,829	1	8,830	10,815
Other	8,771	439	9,210	5,233
	35,150	8,437	43,587	39,443
Expenditure				
Manpower	22,739	902	23,641	28,177
Supplies and services	8,728	1,270	9,998	10,642
Fixed assets	2,297	2,321	4,618	5,538
Joint research ventures	–	1,823	1,823	984
	33,764	6,316	40,080	45,341
Excess (deficiency) of revenue over expenditure	1,386	2,121	3,507	(5,898)
Equity at beginning of year	2,354	5,272	7,626	11,988
	3,740	7,393	11,133	6,090
Transfer from capital reserve	–	–	–	1,536
Equity at end of year	$ 3,740	$7,393	$11,133	$ 7,626

Notes to the Financial Statements

March 31, 1988

Note 1 Authority

The Alberta Research Council operates under the authority of the Alberta Research Council Act, Chapter A-35.1, Statutes of Alberta 1981.

Note 2 Summary of Significant Accounting Policies and Reporting Practices

(a) General

These financial statements have been prepared in accordance with generally accepted accounting principles except that purchases of fixed assets are charged to operations in the year of acquisition. Notwithstanding the above, fixed assets are shown on the balance sheet at original cost, or at estimated cost, with the offsetting credit to fixed assets equity.

(b) Capital Leases

Assets acquired under capital leases, which transfer substantially all benefits and risks incident to ownership of the assets, are initially recorded as fixed assets at cost and the related lease obligations are recorded as liabilities. Operations are charged with the capital and interest portions as lease payments are made.

(c) Advances to Joint Research Ventures

Advances to joint research ventures are recorded as assets of the Council. The asset is reduced and a corresponding charge is made to expenditure for the Council's share of joint research venture expenses.

(d) Patents

Expenditures for patents owned by the Council as a result of research activity are not capitalized due to the uncertain value of benefits which may accrue to the Council.

(e) Contract Revenue Recognition

Contract revenue is recognized as costs are incurred, up to the contract maximum and in accordance with contracted cost-sharing ratios. In accordance with generally accepted accounting principles, the Council makes full provision for all known or estimated losses on incomplete contracts as soon as they can reasonably be estimated. Accordingly, revenue is deferred to future years and matched against costs incurred to complete the project.

(f) Investment

The Council is a minority shareholder in International Permeation Inc. The equity allocated to the Council was based on the technological "know how" acquired by International Permeation Inc. from a former company to which the Council provided research and technological expertise and was the majority shareholder.

The Council's equity in the company is not reflected in these financial statements due to the uncertain value of benefits which may accrue to the Council.

(g) Special Purpose Equity

Special purpose equity is to be used only for future expenditures related to those activities listed on Schedule 1.

(h) Trust Liability

Trust funds are contributions received from other government departments under research agency agreements which require the Council to administer the contributions and provide accounting services.

(i) Changes in Financial Position

A statement of changes in financial position is not provided as disclosure in these financial statements is considered to be adequate.

Note 3 *Deferred Pension Costs*

The Council has estimated the liability at year-end for past service pension costs to be $344,427. Total past service pension costs are being amortized on a straight-line basis over seven years at $57,405 per year.

Note 4 *Investment in Limited Partnership*

The Council has purchased one limited partnership unit in Spurt Investment Fund I, a venture capital fund designed solely to make equity investments in seed and early stage technology enterprises. The partnership unit which cost $300,000, was acquired with a payment of $100,000 and a non-interest-bearing promissory note requiring payments of $100,000 on each of October 27, 1986 and 1987. At the request of the partnership, the 1986 and 1987 payments were not made and are now payable upon demand.

As it is uncertain if any benefits will accrue to the Council, the investment is being written off as payments are made. The amount of the investment is summarized as follows:

	1988	1987
Original cost	$300,000	$300,000
Less: Amount written off	100,000	100,000
Book value	$200,000	$200,000

Note 5 *Fixed Assets*

Fixed assets purchased subsequent to April 1, 1981 are valued at cost. Those purchased prior to April 1, 1981 by the Council are at estimated cost.

Included in fixed assets are certain fixed assets purchased as a result of research contracts which specify that the Council does not receive title to the fixed assets purchased until completion of the contract or at the discretion of the sponsor.

Fixed assets comprise:

	1988	1987
Owned by the Council	$46,904,699	$42,803,498
Held by the Council on behalf of other government agencies and third parties	1,199,658	913,737
Owned by the Council and held by joint venture parties	337,661	–
	$48,442,018	$43,717,235

Note 6 *Obligation Under Capital Lease*

Year ending March 31, 1989	$ 650,220
Year ending March 31, 1990	596,035
	1,246,255
Less: Interest	153,229
	1,093,026
Current portion	548.569
	$ 544,457

Note 7 Fixed Assets Equity

	1988	1987
Balance at beginning of year	$42,122,316	$37,014,483
Add: Additions at cost	4,618,472	7,132,763
Physical count adjustment, net	1,306,817	–
Reduction of obligation under capital lease	501,893	–
	48,549,498	44,147,246
Less: Obligation incurred under capital lease	–	1,594,919
Disposals at cost	1,200,507	430,011
Balance at end of year	$47,348,991	$42,122,316

Note 8 Contingency

A statement of claim has been filed against the Council for approximately $500,000 by a former employee for wrongful dismissal. The outcome of this proceeding is not determinable at this time. Accordingly, the Council has not reflected this claim in the financial statements.

Note 9 Obligations Under Operating Leases

Year ending March 31, 1989	$ 344,257
1990	234,556
1991	189,576
1992	156,379
1993	115,040
	$1,039,808

Note 10 Occupancy and Office Furniture Expenditure

Occupancy and office furniture have been provided by the Province of Alberta at no cost and are not reflected in these financial statements.

Note 11 Comparative Figures

The 1987 figures have been reclassified where necessary to conform to 1988 presentation.

Note 12 Approval of Financial Statements

These financial statements were reviewed by management and recommended to the Board for approval.

Schedule of Special Purpose Revenue, Expenditure and Equity

for the year ended March 31, 1988 (thousands of dollars)

	Electronics Test Centre	Office of Science & Technology	Joint Research Ventures Program	Mill Woods/ Devon Fitting Up	Electronics Industry Information Centre	Bio-technology Toll Facility	Total	
Revenue							**1988**	**1987**
Grants from Province of Alberta:								
General Revenue Fund	$1,000	–	$2,697	–	$300	$4,000	$7,997	$3,810
Alberta Heritage Savings Trust Fund	–	–	–	–	–	–	–	565
Contract revenue	439	–	–	–	1	–	440	261
	1,439	–	2,697	–	301	4,000	8,437	4,636
Expenditure								
Manpower	757	–	15	–	119	11	902	891
Supplies and services	629	109	–	68	235	229	1,270	2,415
Fixed assets	122	–	114	320	–	1,765	2,321	1,833
Joint research ventures	–	–	1,823	–	–	–	1,823	–
	1,508	109	1,952	388	354	2,005	6,316	5,139
Excess (deficiency) of revenue over expenditure	(69)	(109)	745	(388)	(53)	1,995	2,121	(503)
Balance at beginning of year	274	181	654	1,330	221	2,612	5,272	5,486
Transfer from operating equity	–	–	–	–	–	–	–	170
Transfer from capital reserve	–	–	–	–	–	–	–	119
Balance at end of year	$ 205	$ 72	$1,399	$ 942	$168	$4,607	$7,393	$5,272

Patents and Publications

Patents

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Kessick, M.A.

Apparatus for progressively removing layers of overburden from an inclined side of a cut. Canada 1064059, USA 4183586
Owen, H.D. and T. Smith

Apparatus for the manufacture of a corrugated waferboard panel. USA 4616991
Bach, L. and E. Stark

Arc welding. Canada 1090427, USA 4295031
Roen, R.A.

Article passing rotary seal. Canada 984862, USA 3907373
Jensen, E.J. and L.M. White

Beneficiation process for oxidized iron ore. Canada 1125030, USA 4246025
Bertram, E.F. and P. Harris

Coal liquefaction process with oil sand bitumen derived solvent. Canada 1160586
Moschopedis, S.E.

Combination solvent injection-electric current application method for establishing fluid communication through heavy oil formation. Canada 1166151, USA 4450909
Sacuta, A.

Desulfurization of fluid coke. Canada 1098464
George, Z.M.

Enhanced oil recovery using electrical means. Canada 1099210, USA 4228854
Sacuta, A.

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Kessick, M.A., Z.M. George and L.G. Schneider

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Kessick, M.A. and C.E. St. Denis

Process for the manufacture of a corrugated waferboard panel. USA 4675138
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Process for the preparation of trans-3-formylbut-2- enenitrile. USA 4374069, Canada 1172644
Chen, S.C. and J.M. MacTaggart

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Ignasiak, B.

Regeneration process for poisoned Claus alumina catalyst. Canada 1097317, USA 4183823
George, Z.M.

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Ruminant feed supplement and process for producing same. Canada 1037768, USA 4044156
Diner, U. and R.M. Elofson

Seedling container. Canada 939905, USA 3788003
Creighton, S.M., D.L. Mitchell and W.C. Kay

Static bending apparatus for grading wood panels. USA 4675138, Canada 1222884
Bach, L. and A.W. Porter

Transition metal catalyst. Canada 1094532, USA 4142993
Gadallah, F. and R.M. Elofson

Transverse vibration apparatus for grading wood panels. USA 4722223
Bach, L. and A.W. Porter

Treatment of oil sands slimes and modified bitumen recovery process. Canada 1138361
Kessick, M.A.

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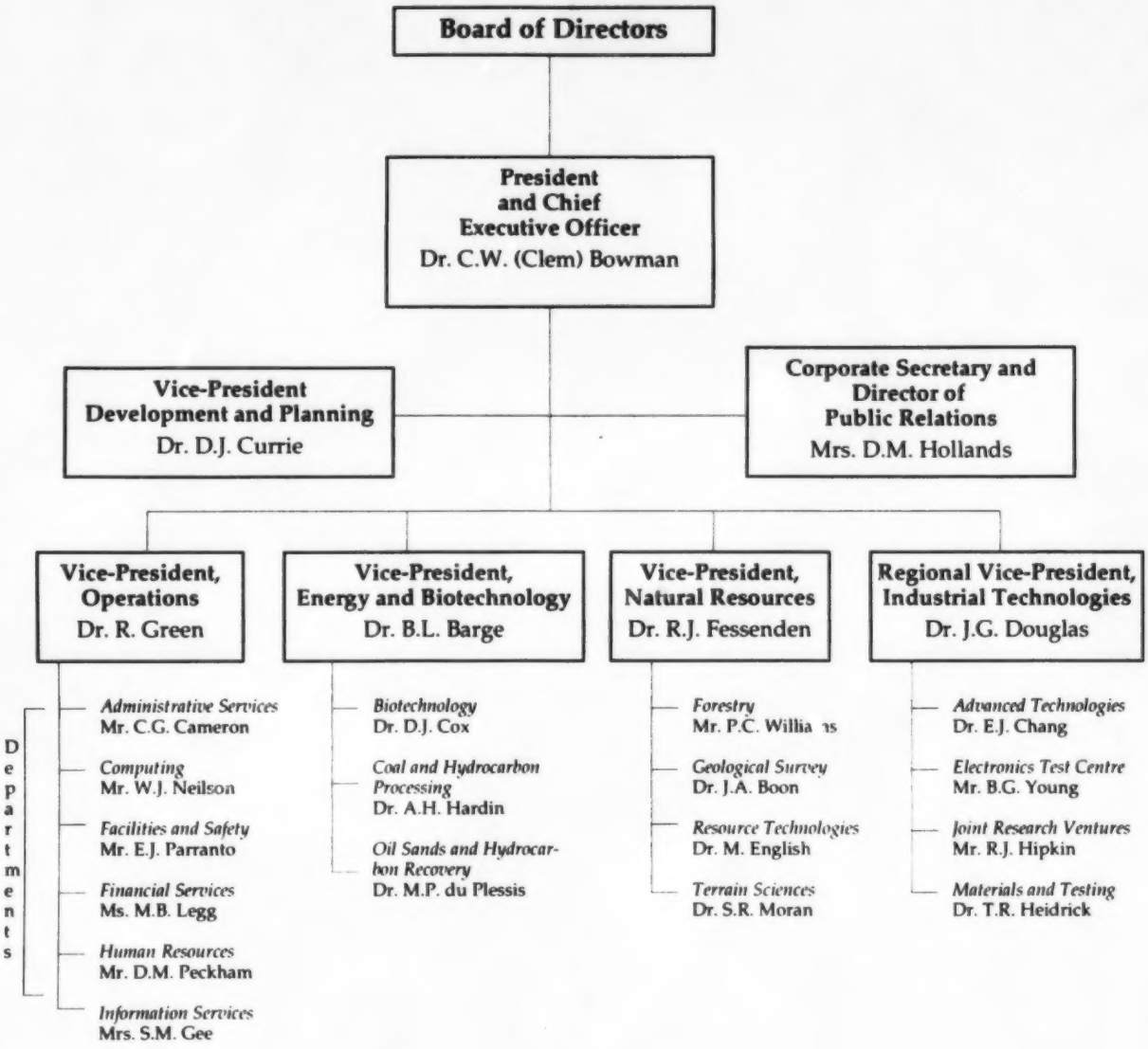

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